Accommodations Toolkit

Color Contrast: Research

This fact sheet on **color contrast** is part of the *Accommodations Toolkit* published by the National Center on Educational Outcomes (NCEO). It summarizes information and research findings on color contrast as an accommodation[1]. This toolkit also contains a summary of states' accessibility policies for color contrast (/nceo/accommodations-toolkit/color-contrast-policies).

What is color contrast? Color contrast provides enhanced visible distinctions between background colors and the color of test content—including images and written text. It is also sometimes called "non-informational color" when offered through electronically-administered test platforms or "color overlays" when provided on a paper/pencil test. These differences are based on darkened or brightened backgrounds. It may also include using brighter or darker edges for graphics and fonts, or negative text (e.g., white font on black background) or other visibly contrasting colors (Botello, 2014; Lee & Zantell, 2002; Zantell et al., 2000).

What are the research findings on who should use this accommodation? Research shows that some students with visual impairments may benefit from using color contrast on assessments (McLaughlin & Kamei-Hannan, 2018). Additionally, research suggests that some students with attention difficulties, such as attention deficit hyperactivity disorder (ADHD), may benefit from using this accommodation (Zentall et al., 2000; Zhang et al., 2014).

What are the research findings on the implementation of color contrast? Five studies were located that addressed the implementation of color contrast.

- All five studies examined the effect of color contrast on student performance. Three studies found that the use of color contrast had positive effects for students with disabilities (Lee & Zentall, 2002; Zentaill, et al., 2000; Zhang et al. 2014). One study had mixed findings (McLaughlin & Kemei-Hannen, 2018) with color contract being beneficial for some students or for some performance measures, while having little effect for others. One study found no effect (Botello, 2014).
    - Three studies examined performance on *reading* assessments. There were mixed findings regarding the benefit of color contrast. One study found a positive effect. Zentall et al. (2000) found that when using color backgrounds with a black font, elementary students with attention-related disabilities performed moderately better on average than with a black-and-white test format. One study had mixed effects. McLaughlin and Kemei-Hannen (2018) in a study of middle and high school students with visual impairments found improved fluency, but that there was little effect on comprehension. Another study found no effect (Botello, 2014).
    - Two studies examined the use of color contrast on *math* assessments. Both found positive effects. Zhang et al. (2014) found improvements in math performance when enhanced color contrast was used in the display of geometric shapes on math assessments for elementary students with substantial difficulties in geometry. Participants with geometry difficulties did significantly better when using enhanced color contrast in comparison to unaccommodated test items. Lee and Zentall (2002) found that for elementary and middle school participants with ADHD, average math performance significantly improved in a high-stimulation testing condition in comparison to a low-stimulation condition. The high-stimulation presentation condition used a colored screen with colored numbers and movement effects while the low-stimulation presented items using static (without movement) black numbers on a gray computer screen.
- One study examined the effect of color contrast on the performance of students with visual impairments. McLauglin and Kamei-Hannan (2018) found fluency improvements—increased reading speed and decreased errors—to a moderate degree during both silent reading and oral reading tasks, when reading from a tablet computer with enhanced background contrast in comparison to reading from paper; however, the study also found that middle and high school students with visual impairments showed no significant differences in reading comprehension between the enhanced contrast and unaccommodated online test conditions.
- Two studies found improved performance for students with attention-related disabilities when color contrast was used. Zhang et al. (2014) showed differential performance benefits of enhanced color contrast for students with attention-related disabilities when compared to students who did not have attention-related disabilities. Lee and Zentall (2002) found that, when using color backgrounds with a black font, elementary

students with attention-related disabilities performed moderately better on average than when a black-and-white test format was used.

- Three studies compared the use of color contrast by students with disabilities with use by students without disabilities. Two study found a positive differential performance boost for students with disabilities (Lee & Zantell, 2002; Zhang et al., 2014); the other found no effect (Bortello, 2014).

What perceptions do students with disabilities and teachers have about color contrast? No studies were identified that examined students' perspectives on the use of color contrast. One study (Davis, 2011) examined teachers' perceptions. A majority of educators who participated in the Davis study indicated that they were relatively knowledgeable about the use of colored overlays; however, some teachers indicated that they did not know when and how to use color overlays for students with various high-incidence disabilities.

What have we learned? The research finding are mixed. Students with disabilities who use the color contrast accommodation have sometimes experienced positive effects on performance, while other times there has been little or no effect. The limited research suggests that color contrast enhancements may be more effective when used for math assessments than for reading assessments. The research also suggests that some students with visual impairments and some students with attention-related disabilities (e.g., ADHD) may find this accommodation useful. There may be a need for professional development on the selection and implementation of color contrast since some educators are not sure how to use this accommodation.

As digital assessment platforms improve, the available options for enhancements in color contrast increase, and there is a need for research on the effectiveness of these emerging options. Additional research is also needed on the effectiveness of color contrast for students with visual impairments since only one study was found that focused on these students. Research is also needed on students' perceptions regarding the use of color contrast since no studies were identified on student perceptions for this accommodation.

Footnotes

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Research on color contrast summarized here is also available in NCEO's searchable *Accommodations for Students with Disabilities Bibliography* (https://nceo.info/Resources/bibliographies/accommodations/bibliography) and in NCEO syntheses of research from 1999 through 2019 (see summaries for: 1999–2001 (https://nceo.umn.edu/docs/OnlinePubs/TechReport34.pdf), 2002–2004 (https://nceo.umn.edu/docs/OnlinePubs/Tech45/Technical45.pdf), 2005–2006 (https://nceo.umn.edu/docs/OnlinePubs/Tech47/TechReport47.pdf), 2007–2008 (https://nceo.umn.edu/docs/OnlinePubs/Tech56/TechnicalReport56.pdf), 2009–2010 (https://nceo.umn.edu/docs/OnlinePubs/Tech65/TechnicalReport65.pdf), 2011–2012 (https://nceo.umn.edu/docs/OnlinePubs/Synthesis94/Synthesis94.pdf), 2013–2014 (https://nceo.umn.edu/docs/OnlinePubs/Report402/NCEOReport402.pdf), 2015–2016 (https://nceo.umn.edu/docs/OnlinePubs/NCEOReport412.pdf), 2017 (https://nceo.umn.edu/docs/OnlinePubs/NCEOReport418.pdf), 2018 (https://nceo.umn.edu/docs/OnlinePubs/NCEOReport423.pdf), 2019 (https://nceo.umn.edu/docs/OnlinePubs/NCEOReport433.pdf)). See the reports and online bibliography for additional information about the criteria used to identify studies included in this fact sheet.

References

Botello, J. A. (2014). *Comparing the effect of two types of computer screen background lighting on students' reading engagement and achievement* (Publication No. 3618650) [Doctoral dissertation, Lindenwood University]. ProQuest Dissertations and Theses Global.

Davis, J. E. (2011). *Secondary education teachers' perceptions related to their knowledge and effectiveness of accommodations for students with mild disabilities* (Publication No. 3618650) [Doctoral dissertation, Lindenwood University]. ProQuest Dissertations and Theses Global.

Lee, D. L., & Zentall, S. S. (2002). The effects of visual stimulation on the mathematics performance of children with attention deficit/hyperactivity disorder. *Behavioral Disorders*, *27*(3), 272–288. http://www.ccbd.net/publications/behavioraldisorders (http://www.ccbd.net/publications/behavioraldisorders)

McLaughlin, R., & Kamei-Hannan, C. (2018). Paper or digital text: Which reading medium is best for students with visual impairments? *Journal of Visual Impairment & Blindness*, *112*(4), 337–351. https://doi.org/https://doi.org/10.1177/0145482X1811200401 (https://doi.org/https://doi.org/10.1177/0145482X1811200401)

Zentall, S., Grskovic, J., Javorsky, J., & Hall, A. (2000). Effects of noninformational color on the reading test performance of students with and without attentional deficits. *Assessment for Effective Intervention*, *25*(2), 129–146. https://doi.org/10.1177/073724770002500204 (https://doi.org/10.1177/073724770002500204)

Zhang, D., Wang, Q., Ding, Y., & Liu, J. J. (2014). Testing accommodation or modification? The effects of integrated object representation on enhancing geometry performance in children with and without geometry difficulties. *Journal of Learning Disabilities*, 47(6), 569–583. https://doi.org/10.1177/0022219413507602 (https://doi.org/10.1177/0022219413507602)

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